

### **REMARKS**

Initially, applicant would like to thank Examiner Nguyen for taking the time to discuss this case on March 31, 2003. In view of that discussion, applicant has amended the claims and provides the following remarks. Entry of the above amendments is respectfully requested.

### **§ 112 Rejection**

In the Office Action, the Examiner rejected claims 1-20 under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification to enable one skilled in the art to make or use the invention. In particular, the Examiner states that the specification is unclear with respect to what "a boost module" is and what does it include. As noted during the March 31, 2003, interview, although applicant believes that the specification is clear regarding the function of the boost module 220, applicant appreciates the Examiner's confusion regarding the same. Based on our discussion during the March 31, 2003, interview and the below remarks, and the present amendments to the specification and drawings, applicant believes this rejection has been overcome.

In particular, with reference to the amended specification, page 9, lines 8-17, presented in our December 6, 2002, Reply, the present invention is directed to a paraboot module 110 that includes a detector module 210 and a boost module 220. The detector module 210 detects a parachuting event, which is described in detail in the specification and in our previous Reply. The output of the detector module 210 is then transmitted to a boost module 220 to increase the oscillator drive signal to ultimately increase the amplitude of the oscillating probe 120 (Fig. 1). Again, by boosting the drive signal to the oscillator to drive the oscillating probe 120, the vibration amplitude of the cantilever 120 is increased, the error signal is increased, and the control module integrates the error more quickly to allow the AFM to more closely track the sample surface.

Moreover, in view of the fact that the applicant appreciates the Examiner's confusion, applicant submits another Request to Approve Drawing Changes to amend Figures 1 and 5 to clarify the above-noted operation. First, Applicant now shows the detector circuit 105 in Figure 1 with the output of the detector circuit 105, in addition to being coupled to control module 150 to maintain a set-point deflection of the cantilever 120, is coupled to the paraboot module 110 (as already shown in Figure 5 - "Phase signal in") to ultimately boost the oscillating drive signal via multiplier 590 and overcome the parachuting problem.

Next, with respect to what the "boost module" includes, applicant has amended Figure 5, which is an exemplary block diagram of paraboot module 110, according to a preferred embodiment. In particular, as shown in Figure 2, paraboot module 110 preferably includes a detector module 210, and a boost module 220. The components of module 210 and 220 are identified in the preferred embodiment shown in amended Figure 5. More particularly, "boost module" 220 may comprise "event level setting" block 580 and "analog multiplier" block 590. Also to be consistent with Figure 2, applicant now shows the phase detection circuit 212 of detector module 210 in Figure 5 and has amended the specification (page 10) accordingly. Of course, these elements define what modules 210 and 220 in Figure 2 could comprise, and are not intended to limit the invention in any additional way. Applicant believes that this amendment should clarify the contents and operation of boost module 220 shown initially in Figure 2.

Applicant again notes its appreciation for the Examiner's diligence in identifying the confusion with the drawings. Applicant also believes that no new matter is being submitted with these drawing changes, as described in further detail in the attached Request. Should the Examiner wish to discuss this issue further, he is asked to please contact the undersigned at the number appearing below.

In sum, in view of the proposed amendments to drawing Figures 1 and 5 and the above discussion, applicant respectfully contends that the operation of the invention has been clarified. As such, applicant contends that the Examiner's rejection under 35 U.S.C. § 112, first paragraph, has been overcome, and an indication to that effect is respectfully requested.

**§ 102(b) Rejection**

Next, the Examiner rejected claims 1, 9 and 19 under 35 U.S.C. § 102(b) as being anticipated by *Hlady et al.*, U.S. Patent No. 5,700,953. With particular reference to *Hlady et al.*, applicant notes that *Hlady et al.* simply teach a simple feedback circuit to monitor a surface property, a common feature of known AFMs. *Hlady et al.* do not provide any teaching with respect to compensating for "parachuting" of the probe during operation of the AFM by boosting the drive. Note that the present boost of the drive to compensate for probe parachuting should not be confused with the well-known technique of using feedback to generate control signals during operation. Such control signals are used to modify tip-sample separation to maintain, for example, a set-point amplitude of oscillation and are indicative of the sample property being analyzed. This is essentially what *Hlady et al.* teach. As discussed at Col. 4, ll. 54-67, *Hlady et al.* teach operating an atomic force microscope by using feedback to control the position of the z-piezo drive (i.e., the probe connected thereto) relative to the sample, i.e., to control probe-sample separation. *Hlady et al.* do not teach altering the output of the z-piezo drive by detecting what has been defined in this application as a "parachuting event."

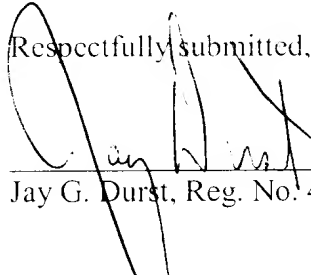
The present invention indeed uses feedback to generate control signals indicative of a sample characteristic. However, the boost provided to alter the output of the drive in response to a detected parachuting event is a separate operation, an operation which is the subject of this invention. As clarified in amended Figure 1, the detector circuit 105 detects changes in cantilever oscillation and corresponding signals are coupled to two independent circuits. First, the output is applied to a typical AFM feedback arrangement (represented by control module 150) to maintain a set-point oscillation, the control signals provided by the feedback arrangement being indicative of a sample characteristic. Second, the output is used as an input to a paraboost module 110 that (1) detects whether a parachuting event is occurring, and then (2) boosts the signal to minimize the adverse effects associated with a parachuting probe during a scan. No such circuitry, as defined in independent claims 1, 9, 19 (each amended for clarification purposes based on the March 31, 2003, interview), is provided, nor suggested by *Hlady et al.*

In view of the above, applicant respectfully contends that claims 1, 9, and 19, as well as their respective dependent claims, are novel and non-obvious over the teachings provided by *Hlady et al.*, and as such are allowable. An indication to this effect is respectfully requested.

Should the Examiner have any questions or comments, or wish to discuss this case in detail for any reason, he is invited to contact the undersigned at the number below.

A Petition for a two (2) month Extension of Time Under 37 CFR 1.136(a) and a check in the amount of \$410.00 is enclosed. The Director is authorized to direct any additional fees associated with this or any other communication, or credit any overpayment, to Deposit Account 50-1170.

Respectfully submitted,

  
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## APPENDIX SHOWING THE CHANGES FOR SN 09/761,792

### In The Drawings:

Applicant, in response to the objection by the Examiner, submits the attached "Request to Approve Drawing Changes."

### In The Specification:

Please replace the paragraph in the specification at page 8, lines 3-22, with the following rewritten paragraph:

In controlling the Z-module, the paraboot module 110 **[detects] processes** oscillation amplitude, phase, and/or other properties of the probe 120. These properties are detected, for example, by processing the signals produced by any number of standard detector schemes **105**, such as a laser reflecting off the back side of the cantilever and onto a bi-cell or quad detector **[105]**. An error signal from the detector is sent to the control module 150. If the oscillation amplitude of the probe 120 is too high, for example, the non-zero error signal is integrated and accumulated by the control module 150. When enough error signal is integrated, the control module 150 commands the Z-module 140 to lower the probe 120 towards the surface 170. The error is integrated so that abrupt changes are not detected too quickly, which may cause the Z-module 140 to engage in unwanted oscillation. If the probe 120 encounters a deep recess 175 in the surface 170, it is desirable to lower the probe 120 to the bottom of the recess 175 as quickly as possible. In conventional devices, this is accomplished by increasing the gain of the error signal. Unfortunately, high gain makes the system susceptible to instability of the Z-module. In the present invention, however, no such Z-module instability occurs when the probe is lowered quickly because instead of increasing gain of the error signal, probe oscillation is increased by boosting the probe drive signal. This causes the error signal to accumulate more rapidly in the control module 150 which causes the Z-module 140 to lower the probe 120 more rapidly.

Therefore, the Z-module 140 responds to and reduces parachuting of the probe 120 without causing the probe to oscillate or become unstable.

Please replace the paragraph on page 6, line 21 to page 7, line 11, with the following rewritten paragraph:

--In overview, the paraboost module 110 detects operation of the probe 120, including parachuting of the probe 120 and, indirectly, boosts an error signal sent to the control module 150. The control module 150 controls movement and location of the probe 120 with respect to the surface 170. In particular, the control module 150 controls the distance between the probe 120 and the surface 170 based on detected operational parameters of the probe. The control module 150 may include an additional signal processor which operates in response to error signals from the paraboost module 110. For example, the control module 150 may integrate an error signal from the paraboost module 110 caused by under or over oscillation of the probe 120. The control module 150 then adjusts the distance between the probe 120 and the surface 170 to compensate for the error signals. For example, the control module 150 lowers the probe 120 if the paraboost module 110 or another sensor detects that the probe 120 is too far from the surface 170.--

Please replace the paragraph on page 10, lines 4 to 10, with the following rewritten paragraph:

--Fig. 5 is an exemplary block diagram of the paraboost module 110 according to a preferred embodiment. The paraboost module 110 includes a detector module 210 having a phase detection circuit 212, a differential amplifier 510, a precision full-wave rectifier 520, a clamp and gain circuit 530, an envelope detector 540, a comparator with hysteresis circuit 550, an event detector and hold off circuit 560, a correction period and reset event detector circuit 570, and a boost module 220 having an event level setting circuit 580, and an analog multiplier 590. Figs. 6-10 are exemplary illustrations of a phase signal at stages 1-g of the paraboost module 110. --

Please replace the paragraph on page 10, lines 11 to 20, with the following rewritten paragraph:

--In operation, the paraboot module 110 detects parachuting of the probe 120 based on the probe phase signal when the phase signal quiets as illustrated in Fig. 6, waveform (a). In particular, the phase signal waveform (a) enters the paraboot module 110 through the differential amplifier ~~110~~ 510 at location (a). The differential amplifier 510 is useful to reduce noise of the signal when the paraboot module 110 is relatively far from the sensors detecting the phase of the probe 120. The amplified phase signal then enters a precision full-wave rectifier 520 and then is rectified to produce full-wave rectified waveform (b). Waveform (b) then enters a clamp and gain circuit 530 and proceeds through an envelope detector 540 which converts the ragged edges into perimeter edges to produce the envelope detected waveform (c) illustrated in Fig. 7. --

Please replace the paragraph on page 11, lines 6-16, with the following rewritten paragraph:

--Waveform (d) then enters correction period with reset event detector circuitry 570 to produce waveform (e). As illustrated in Fig. 8, and discussed above, the event detector and hold off circuitry 560 and the correction period and reset event detector circuitry 570 ignores false events, such as those that are less than one millisecond. Accordingly, on events that are greater than one millisecond are detected and output as a dashed line waveform (e). Waveform (e) then enters event level setting circuitry 580 to adjust the pulse of the waveform (e) to the desired level by using a level setting input and to produce waveform (f) as illustrated in Fig. 9. Waveform (f) then proceeds through an analog multiplier 590 where it is combined with the cantilever drive signal to boost the drive amplitude resulting in waveform (g) as illustrated in Fig. 10. Boosted drive amplitude waveform (g) is then used to drive the probe 120. **Note, if a parachuting event is not detected, the cantilever drive is applied directly to oscillator 130 (Figure 1).** --

**In The Claims:**

Please cancel claim 5.

Please amend the claims as follows:

1. (Amended) An apparatus for reducing the parachuting of a probe measuring the topography of a surface comprising:
  - an oscillating probe;
  - a **[phase detection circuit] detector module operatively** coupled to the oscillating probe; and
  - a **[probe drive boosting circuit] boost module** coupled to the **[phase detection circuit] detector module** and the probe,wherein, the **[phase detection circuit] detector module** detects a reduction of a variation of a phase signal from the probe and the **[probe drive boosting circuit] boost module** boosts a **cantilever drive** signal to the probe based on the phase signal detected by the **[phase detection circuit] detector module** to produce a boosted probe drive signal.
2. (Amended) The apparatus according to claim 1, wherein the **[phase detection circuit] detector module** comprises:
  - a precision full wave rectifier; and
  - an envelope detector coupled to the precision full wave rectifier,wherein the precision full wave rectifier rectifies a phase signal of the probe to produce a rectified phase signal and the envelope detector detects the rectified phase signal to produce an envelope detected signal.



3. (Amended) The apparatus according to claim 2, wherein the **[phase detection circuit] detector module** further comprises:

a comparator coupled to the envelope detector; and  
an event detector and hold off circuit coupled to the comparator,  
wherein the comparator and the event detector and hold off circuit generate  
an event signal from the envelope detected signal.

4. (Amended) The apparatus according to claim 3, wherein the **[phase detection circuit] boost module** further comprises a multiplier coupled to the event detector and hold off circuit; and

wherein the multiplier combines the event signal with a probe driver signal to produce  
the boosted probe drive signal.

6. (Amended) The apparatus according to claim 4, **[further comprising] wherein the boost circuit further comprises** an event level setting circuit coupled between the event detector and hold off circuit and the multiplier **of the boost circuit**, wherein the event level setting circuit sets an event level of the event signal.

9. (Amended) A method for reducing the parachuting of a probe obtaining accurate information representative of a surface of a sample comprising:

scanning the surface of the sample with an oscillating probe;

**measuring an oscillation of the oscillating probe so as to generate  
a phase signal;**

detecting a reduction of a variation of **[a] the** phase signal of the probe indicative  
of free oscillation of the probe; and

reducing a distance between the probe and the sample in response to the detection  
of the reduction of the variation of the phase signal of the probe.

19. (Amended) An apparatus for reducing the parachuting of a probe measuring the topography of a surface comprising:

an oscillating probe;

a detection module [parachuting detection circuitry] coupled to the oscillating probe to detect parachuting of the probe;

a boost module [parachuting reduction circuitry] coupled to the [parachuting detection circuitry] detection module.

wherein the [parachuting reduction circuitry] boost module reduces the parachuting of the probe in response to the detection of parachuting of the probe.

20. (Amended) The apparatus according to claim 19, wherein the parachuting detection circuitry comprises a [phase detection circuit] detector module and the parachuting reduction circuitry comprises a [probe drive boosting circuit] boost module.